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Impact of energy efficiency measures on the economic value of buildings

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ABSTRACT

A main objective of energy policies is to make all levels of the society, from governments to citizen, interested in increasing the energy efficiency of buildings. One of the most important barriers in implementation of energy policies is that the cost of potential energy savings, typically considered being the only financial benefit, does not sufficiently motivate investments. The target is therefore to identify further possible drivers pushing positive reaction according to energy saving action.

The paper discusses whether a market-based instrument, capturing the increase of the economic value of energy efficient buildings, can be also used. Methods that quantify the added value due to energy performance, including recommendations on how they can be incorporated in the financial analysis of investments in weatherization, are developed. By applying the proposed methods, the payback period of investments in energy efficiency measures depends on two factors: potential energy savings and the added value to the property. Case studies on some existing condominiums from Romania are analyzed and provide evidence to the research question.

The market sensitivity to energy efficiency measures, the possibility of an intangible added value as well as the impact to financial investment decisions is subsequently in the focus.

1. Introduction

Buildings represent the largest sector of primary energy consumption and the biggest contributor to world greenhouse gas emissions (GHG). High performing energy buildings have a starring role in energy saving policies. Key parts of EU energy legislation are the Energy Performance of Buildings Directive 2002/91/EC (EPBD) [1] and the Directive 2006/32/CE on energy end-use efficiency and energy services (EEESP) [2]. Energy policy involves the planning and the design of efficient solutions from a multidisciplinary perspective to determine optimal solutions [3]. The energy saving potential of existing buildings and energy efficiency measures are top research subjects all over the world, focusing on a wide range of topics: energy conservation regulations [4], Life Cycle Assessment [5], benchmarking methodologies for building energy-use performance [6], best energy saving measures for different climates and locations [7–9], influence of the envelope characteristics on the cooling/heating system [10,11], etc.

Even in countries that had implemented the EPBD directive years ago, many questions regarding its impact, extent and enforcement are still being raised [12–14]. For instance, in [15] several assessments of the energy performance of buildings methodologies scheduled in the Italian Law were tested and compared.

A study on how owners have interpreted and used the knowledge from energy audits for the renovation of their house reveals that aesthetics, identity and convenience may be viewed sometimes as relevant as energy savings [16]. Even when the owners are likely to invest more in energy efficiency measures that provide faster returns, visibility of investments is important, therefore new windows are preferred comparing to attic insulation, which has higher energy saving potential [17].

Improvements to the energy efficiency of buildings are slowed when energy expenses are a very small fraction of the resident/owner's income. According to Lior [18], energy policies would be "much more effective if the tangible benefits would become significant, using market forces rather than just legislation". A solution is suggested by Kragh and Rose who analyzed the possibilities of utilizing the relatively cheap long-term mortgage loans to finance energy renovation investment using equity [19]. Another solution to motivate residents and owners could be using a market driven reason, such as higher prices for buildings that have undergone energy efficiency measures.

Since every real estate market is different, many studies are needed to find out if investments in energy performance really translate into economic value. If the answer is yes, developing

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Nomenclature

CE	actual cost of the unit of energy (€/kW h)
d	annual depreciation of the currency (–)
ED	annual energy demand (kW h/m^2 year)
ES	annual energy savings (kW h/m^2 year)
f	annual increase rate of energy price (–)
i	discount rate (%)
I	investments costs for energy efficiency measures (€/m^2)
NPV	net present value of costs of energy savings (€/m^2)
P	price of the property (€/m^2)
S	floor area (m^2)
t	payback period (years)
tR	lifetime of the retrofitting (years)
V	adjusted value of the property (€/m^2)
ΔV	added value due to energy performance (€/m^2)

Greek letter

α	transaction coefficient (%)
β	market coefficient (–)

Superscript

–	average
α, β	calculated by using coefficient α, β

Subscript

1	before retrofitting
2	after retrofitting
j	type of energy (e.g. $j = 1$ for gas, $j = 2$ for electricity, $j = 3$ for district heating, etc.)
N	non-retrofitted building
R	retrofitted building

methods of the quantification of the added value due to energy performance would be helpful in improving energy audit methodologies. An energy audit is a detailed report on the energy characteristics and on the recommended measures to increase energy efficiency, including economic analysis of profitability, monitoring the impact of energy policies, developing appraisal methodologies that take energy efficiency into consideration, etc. Cost is not necessarily value, therefore supposing that investments in retrofitting for better energy efficiency payback totally, when the building is sold is not possible.

The financial analysis of benefits due to applying energy policies in buildings is usually treated from unilateral points of view. Energy auditors answer to questions of whether investments in energy efficiency pay off by analyzing only the costs of potential energy savings [20,21], while real-estate appraisers analyze only the extend to which such investments increase the value of the building [22,23].

Identifying and quantifying multiple benefits of energy efficiency is a new trend in the energy field. The International Energy Agency's Energy Efficiency Unit has recently begun research work on innovative energy efficiency policies to increase the interest on weatherization programs for low-income households [24]. Weatherization is the practice of modifying a building to reduce energy consumption and optimize energy efficiency and protecting a building and its interior from the elements, particularly from sunlight, precipitation, and wind. The interest on the topic is argued by the fact that low-income energy efficiency programs just compare actual/ projected energy bill reductions with spending to determine whether the program is cost-effective, while important co-benefits such as direct and indirect socio-economic benefits in the form of increased property value and economic activity and other co-benefits to households (e.g. improved health and comfort) are neglected. The scope of the project is inclusion of co-benefits in program evaluation protocols, which is expected to lead to a higher priority for low-income household energy efficiency investments assisted by governments.

Entrop et al. developed a method that incorporates the annual increase/decrease of the value of the building according to fluctuations of transaction prices in the financial analysis of the cost of energy savings [25]. By applying their method, the payback period decreases when prices of properties increase and it increases when transaction prices decrease.

The methods presented here analyze financial benefits in a different way, by considering that the increased value of buildings depends on the willingness to pay more for energy performance. We appreciated that if the buyer is not interested in the energy efficiency of a property, the only reasonable benefit of applying energy efficiency measures is lower operating costs and there are no gains of value to be considered in the financial analysis. On the other hand, if the buyer agrees to payback, let us say 90% of the investments in energy efficiency measures which ever way the real estate market fluctuates, costs of further energy savings are not so important.

The main purpose of the present study is to develop methods that can quantify the increase in the value of the building generated by applying energy efficiency methods. The proposed original method considers both the net present value of the costs of energy savings, and the added value due to energy performance in the financial analysis. Financial analysis of energy efficiency measures for any purpose, such as conducting an energy audit of an existing building (an energy audit is a detailed report on the energy characteristics and on the recommended measures to increase energy efficiency, including economic analysis of profitability), monitoring the impact of energy policies, making an appraisal of a property, should not neglect either of them.

Other scope of the present paper is to get a better understanding of how energy performance is seen by owners/tenants in their double role, as energy consumers and as real-estate customers. Besides, short term motivations, like saving on energy costs or increasing the transaction price, the owners might be interested in energy performance by other reasons. One of them is that the property market tenants focus more and more on energy efficiency due to rising energy prices, therefore the owner has to follow the demand of the market to stay competitive and not to have an obsolete property. On the other hand, there are shareholders, especially in listed companies, that have to act in line with the so-called "Corporate Social Responsibility" (CSR), which includes sustainable and environmental aspects. Energy efficiency is a necessity in this case, not just an option.

The first part presents arguments for why studies are needed to identify more links between the energy performance of buildings and their economic value. In order to analyze whether energy efficiency can really translate into added value of real-estate asset, the second part of the paper contains information about the sensitivity of some non-European and European countries to sustainable, green or just energy efficient buildings. The third section presents original methods for analyzing the financial benefits of applying energy efficiency measures, by including the added value due to energy performance within the financial analysis of investments. A survey on some existing condominiums from Romania, a